

Teeth Bleaching Efficacy During Clear Aligner Orthodontic Treatment

Rhoda J. Sword, DMD; and Van B. Haywood, DMD

Abstract: Clear aligner treatment has become popular for many orthodontic cases that ordinarily would have required traditional orthodontic brackets and wires. One of the motivating reasons for patients to use clear aligner therapy is to improve their esthetic appearance, which typically is the same motivation for teeth bleaching, thus a combination of the two treatments may be desirable. The case report presented demonstrates bleaching concurrent with clear aligner (Invisalign®) treatment. A concern about bleaching during such treatment is that the areas on the tooth under the composite attachments, or buttons, used to retain the clear aligner trays may remain unbleached. However, due to the small molecular size of the bleaching material agent and its ability to permeate the tooth, the area under the attachment will be bleached as well. With this understanding, a practitioner can treat patients more efficiently by being able to complete bleaching treatment simultaneously with clear aligner treatment.

The orthodontic treatment process known as clear aligner therapy, namely the Invisalign® system (Align Technology, Inc., aligntech.com) and other similar systems, has become a popular treatment modality for many cases that would have otherwise needed traditional orthodontic brackets and wires.¹ With the Invisalign clear aligner method, patients have the flexibility of removing the aligner trays during meals and for cleaning while still undergoing orthodontic treatment. Although patient compliance has the potential to be slightly compromised depending on the user's ability to remove the trays, this method is quite popular with patients and offers several inherent benefits, including the fact that the challenge of brushing and flossing around traditional orthodontic brackets and wires is eliminated. With the tray removed, the patient can brush and floss as usual, which can alleviate the concern regarding the formation of white hypocalcified areas that often accompany the hygiene issues affiliated with traditional orthodontic treatment.

The clear aligner technique employs a fairly rigid custom-fitted tray that is used to perform the movement of the teeth; composite attachments, or buttons, are bonded to several teeth to aid in the retention of the orthodontic tray. Although patients undergoing this treatment do not have to contend with the drawbacks associated with brackets and white spot lesions, the composite attachments on the teeth can compromise oral hygiene due to their irregular shapes protruding from the teeth.²

One of the motivating reasons for orthodontic treatment is improved esthetics. A better esthetic appearance is also a prime motivation for teeth bleaching; therefore, combining the two treatments may be beneficial to patients for several reasons. Patients undergoing clear aligner treatment already have aligner trays, so a possible approach to bleaching for these patients would be the use of their existing tray as the delivery mechanism for bleaching material. This approach can be highly cost-effective, because separate impressions and trays would not have to be made for a patient interested in bleaching. Although some advocates of bleaching encourage the use of scalloped trays with reservoirs for the bleaching material, studies have shown that bleaching with non-scalloped, non-reservoir trays using 10% carbamide peroxide bleaching material is just as safe and also can conserve bleaching material.³⁻⁵ Hence, these trays could accommodate bleaching treatment with 10% carbamide peroxide. Also, bleaching during clear aligner treatment can improve oral hygiene and further minimize the potential for white spot lesions.⁶

One possible concern among patients bleaching during clear aligner treatment is the potential for a lack of color change on the portion of the tooth covered by the composite attachment. The concern is that upon removal of the attachment, or button, the area of the tooth underneath it would not be bleached, leaving a discolored, yellowish spot on the tooth. The purpose of this article is to allay concerns of having a yellowish unbleached area on the tooth where the composite button is located when bleaching teeth during clear aligner orthodontic therapy.

Case 1

A 23-year-old male patient undergoing clear aligner (Invisalign) treatment presented with composite buttons on teeth Nos. 6, 12, 21, and 28 and was interested in bleaching to lighten the shade of his teeth. He was taking no medications, and his medical and dental histories were noncontributory.

The patient did not realize he had the choice of undergoing bleaching treatment either concurrent with clear aligner therapy or after its completion. It is often presumed that bleaching requires a particular tray with reservoirs and scalloping. However, when using 10% carbamide peroxide, any tray design that closely approximates the teeth and extends onto the tissue can be used for bleaching with this low concentration of material. Originally, 10% carbamide peroxide was used as an oral antiseptic designed to be put on the gingival tissue. Research has shown that the use of 10% carbamide peroxide in bleaching has resulted in improved gingival scores as well as tooth bleaching,^{7,8} thus any reasonable tray design can be effective. Another frequent concern is whether there will be “spots” left on the portions of the tooth that are covered by an orthodontic bracket; however, research has shown that the peroxide penetrates completely through the enamel and dentin, and bleaching occurs under existing restorations or brackets.⁹ Once the patient realized he did not have to wait until the end of aligner treatment when the buttons were removed to pursue

bleaching, he chose to undergo the bleaching treatment during clear aligner treatment.

The mandibular arch was chosen for treatment first, as it is recommended that bleaching be performed one arch at a time so the patient can better evaluate the difference between the treated and untreated arches.¹⁰ In this case, the patient was more concerned about the esthetics in the mandibular arch than the maxillary arch, thus the decision to initiate treatment on the mandibular arch. The patient's clear aligner trays were evaluated for fit in the mouth (Figure 1). A 10% carbamide peroxide bleaching material (Opalescence™ 10% PF, Ultradent Products, Inc, ultradent.com) was dispensed, and the patient was instructed to apply one drop of the bleaching material per tooth in the tray every night and to wear the tray overnight. Although the patient had slight modeling of his teeth, the initial shade of the middle third of the mandibular teeth taken with a VITA classical A1-D4® shade guide (VITA Zahnfabrik, vita-zahnfabrik.com) prior to initializing bleaching was A3.

After a month of nightly bleaching the patient was re-evaluated, and the mandibular teeth were deemed A1, with an obvious difference in color apparent between the maxillary and mandibular teeth (Figure 2). This change in color demonstrated that the trays can be used for vital bleaching (Figure 3).

Next, the removal of the composite buttons after treatment would determine if the bleaching method can be considered completely



Fig 1. Case 1. Patient before bleaching with clear aligner trays in place. **Fig 2.** Patient after bleaching mandibular arch nightly for 1 month with clear aligner trays in place, demonstrating the efficacy and safety of bleaching during aligner treatment. **Fig 3.** After bleaching, but with the composite buttons still in place, a color change was demonstrated. **Fig 4.** Patient after bleaching of mandibular arch and removal of composite buttons; there was no remaining unbleached area in the button location of tooth No. 21.



Fig 5. Case 2. Patient prior to clear aligner therapy who was also interested in bleaching. **Fig 6.** Pre-bleaching shade of the maxillary left canine with a composite button. **Fig 7.** Pre-bleaching shade of the maxillary right canine with a composite button. **Fig 8.** Post-bleaching shade prior to removal of composite buttons.

successful and a valid treatment modality or if further bleaching would be required to remove any yellowish unbleached area under the button. A day after the 1-month bleaching photographs were taken, the orthodontist removed the buttons. As shown in a photograph taken immediately after button removal (Figure 4), no noticeable yellowish unbleached area was present on the facial surface of tooth No. 21 where the composite button had been bonded.

Case 2

A 23-year-old female patient undergoing clear aligner (Invisalign) treatment presented with composite buttons on teeth Nos. 4 through 7, 11 through 13, 20, 22, and 28 and was interested in bleaching to lighten the shade of her teeth. The only medications she was taking were for birth control on a regular basis and allergy symptoms (Claritin[®]) only as needed. Her medical and dental histories were noncontributory.

Like the previous patient, this patient was unaware that teeth bleaching could be performed simultaneous to orthodontic treatment using the existing aligner trays, and she expected to be able to do the bleaching only when the orthodontic treatment was completed. However, once the patient realized she had the choice of undergoing bleaching treatment concurrent with her clear aligner therapy rather than wait until after its completion she opted to do so.

In this case the patient chose to begin treatment on the maxillary arch because in her estimation it was the more unappealing of the two arches esthetically. The patient's pre-bleaching shade photographs

were taken (Figure 5) and aligner trays were evaluated for fit in the mouth. A 10% carbamide peroxide bleaching material (Opalescence 10% PF) was dispensed, and the patient was instructed to apply one drop of the bleaching material per tooth in the tray every night and to wear the tray overnight. The shade of the maxillary teeth was taken in the middle third of the teeth using a VITA classical A1-D4 shade guide. The shade was A2 for the canines (almost A3 at the gingival) and B1 for the incisors (Figure 6 and Figure 7).

The patient was re-evaluated after 1.5 months of nightly bleaching (Figure 8); the maxillary incisors were still B1, and the canines were closer to A1. This change again demonstrated that the aligner trays can be used successfully for vital bleaching. Then, after almost 2 months of bleaching, the buttons were removed by the orthodontist, and photographs were taken immediately and 1 week later. No noticeable yellowish unbleached blemishes were apparent on the facial surfaces of teeth Nos. 6 or 11 where the composite buttons had been bonded (Figure 9 and Figure 10).

Discussion

The vital tooth tray bleaching procedure developed by Haywood and Heymann in 1989 has been shown to change the color of both enamel and dentin.¹¹ The carbamide peroxide molecule is small enough to penetrate through the enamel interprismal spaces and dentin in 5 to 15 minutes.⁹ This effective penetration changes the color of the underlying dentin and therefore the color of the actual tooth. It similarly has also been demonstrated to change the color of

the tooth under porcelain veneers by bleaching from the lingual.¹²

Early research has indicated that just as a portion of the tooth cannot be “spot bleached” due to the permeability of the tooth and the capillary action of the peroxide, a spot or area on the tooth conversely cannot be isolated from the bleaching process.¹³ With the method of bleaching in the vital tooth tray bleaching procedure, the carbamide peroxide would reach the dentin subjacent to the composite button used in the clear aligner system as well as the surrounding dentin. This phenomenon causes the color of the tooth to change throughout the entire tooth and surface and not just where the bleach comes into actual direct contact. Therefore, upon removal of the composite button it can be expected that a thoroughly bleached tooth will result without yellowish unbleached areas under the composite button area. If there were to be any yellow areas, they would most likely be residual composite from the bonding procedure, which embeds into the tooth at least 25 microns because of the acid-etch step in the bonding procedure.¹⁴ Abrasion techniques are used after debonding orthodontic brackets to remove this composite.

Based on this information, the authors have presented a technique that enables bleaching concurrent with clear aligner orthodontic treatment. This method can save on material usage and time because of streamlined procedures. The patient uses an already-existing tray and can undergo the bleaching process during orthodontic treatment rather than waiting until it is completed. Additionally, bleaching tray fabrication is eliminated.

Because the composite button must be retained to ensure the correct placement of the orthodontic tray, it is reasonable to question what effect the carbamide peroxide might have on the bond of this attachment and its potential to debond. The carbamide peroxide bleaching material has been shown to actually strengthen the composite bond in a chemically cured composite and have no effect on a light-cured composite.¹⁵ Generally, composite cures only about 70%, so the additional carbamide peroxide further increases the bond strength of the brackets by supplying oxygen. The opposite of this is true if bleaching is performed immediately prior to bonding. In that case, the residual oxygen in the tooth from bleaching reduces the bond strengths by 25% to 50%.¹⁶ Patients should wait at least 2 weeks after bleaching before any bonding procedure is attempted to allow the complete dissipation of the oxygen from the enamel.¹⁰ However, once the composite material has been polymerized, then bleaching over the bonded composite will either further polymerize the composite or leave it unaffected. For this reason, the dentist will have to coordinate the timing of the bleaching application and the tray sequencing if additional composite bonded buttons are needed during treatment.

Sensitivity may often occur during traditional orthodontic treatment as well as clear aligner treatment.¹⁷ Bleaching trays have proven to be a useful delivery method for potassium nitrate-fluoride for sensitivity treatment.^{8,18,19} The sensitivity could be a result of the orthodontic movement or the bleaching process. In either case, a 10- to 30-minute application of 5% potassium nitrate, either from a professionally supplied product or by using a desensitizing toothpaste in the tray, can reduce or eliminate sensitivity in more than 90% of patients.¹⁰ Hence, the availability of the clear aligner trays provides an effective method to address any sensitivity during treatment.



Fig 9 and Fig 10. Post-bleaching shade of the maxillary right (Fig 9) and left (Fig 10) canines taken 1 week after removal of the composite buttons demonstrated bleaching occurred under the buttons and throughout each tooth.

Additional benefits of using 10% carbamide peroxide in the clear aligner tray may be improved oral hygiene and reduction of caries. All bleaching studies of 10% carbamide peroxide have shown an improvement in gingival indices during treatment.⁶ It has been reported that orthodontic patients who wear a traditional bleaching tray over traditional braces to apply 10% carbamide peroxide during orthodontic treatment may experience a caries control benefit in addition to tooth whitening.⁶ A challenge of this caries control treatment was the cost of fabricating custom-fitted bleaching trays every few months to fit over the braces due to teeth movement from the orthodontic treatment. One solution to this challenge has been the use of custom-fitted “boil and form” trays made directly in the mouth over the braces that do not require an alginate impression or vacuum-formed matrix system. While removable clear aligner therapy simplifies hygiene considerably compared to traditional orthodontic brackets and bands, the ability of the bleaching material to help control caries is an added benefit.

Conclusions

Two case reports demonstrated that a clear aligner (Invisalign) tray can be used as a successful bleaching tray during aligner therapy and that the bleaching is effective in changing teeth color without leaving a yellowish unbleached portion of the tooth where the composite button was bonded. The concern that bleaching while the composite button is on the tooth will leave a discolored portion of the tooth is unwarranted. When performed during clear aligner

treatment, this approach offers patients a more time-efficient and less costly option for bleaching and can potentially treat sensitivity, impact gingival health, and reduce caries.

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ABOUT THE AUTHORS

Rhoda J. Sword, DMD

Associate Professor, Department of Restorative Sciences, Augusta University, Augusta, Georgia

Van B. Haywood, DMD

Professor, Department of Restorative Sciences, Augusta University, Augusta, Georgia

REFERENCES

1. Vlaskalic V, Boyd R. Orthodontic treatment of a mildly crowded malocclusion using the Invisalign System. *Aust Orthod J*. 2001;17(1):41-46.
2. Levrini L, Mangano A, Montanari P, et al. Periodontal health status in patients treated with the Invisalign® system and fixed orthodontic appliances: a 3 months clinical and microbiological evaluation. *Eur J Dent*. 2015;9(3):404-410.
3. Haywood VB, Leonard RH Jr, Nelson CF. Efficacy of foam liner in 10% carbamide peroxide bleaching technique. *Quintessence Int*. 1993;24(9):663-666.
4. Javaheri DS, Janis JN. The efficacy of reservoirs in bleaching trays. *Oper Dent*. 2000;25(3):149-151.
5. Miller MB, Castellanos IR, Rieger MS. Efficacy of home bleaching systems with and without tray reservoirs. *Pract Periodontics Aesthet Dent*. 2000;12(6):611-614.
6. Lazarchik DA, Haywood VB. Use of tray-applied 10 percent carbamide peroxide gels for improving oral health in patients with special-care needs. *J Am Dent Assoc*. 2010;141(6):639-646.
7. Selem D, Lazarchik D, Dadjoo S, et al. Effect of 10% carbamide peroxide on tooth shade, plaque index, and gingival index during Invisalign treatment [abstract]. *J Dent Res*. 2020;99(spec iss A):Abstract 1587.
8. Curtis JW, Dickinson GL, Downey MC, et al. Assessing the effects of 10 percent carbamide peroxide on oral soft tissues. *J Am Dent Assoc*. 1996;127(8):1218-1223.
9. Cooper JS, Bokmeyer TJ, Bowles WH. Penetration of the pulp chamber by carbamide peroxide bleaching agents. *J Endod*. 1992;18(7):315-317.
10. Haywood VB. The "bottom line" on bleaching 2008. *Inside Dentistry*. 2008;4(2):82-89.
11. McCaslin AJ, Haywood VB, Potter BJ, et al. Assessing dentin color changes from nightguard vital bleaching. *J Am Dent Assoc*. 1999;130(10):1485-1490.
12. Haywood VB, Parker MH. Nightguard vital bleaching beneath existing porcelain veneers: a case report. *Quintessence Int*. 1999;30(11):743-747.
13. Bowles WH, Ugwuneri Z. Pulp chamber penetration by hydrogen peroxide following vital bleaching procedures. *J Endod*. 1987;13(8):375-377.
14. Swift EJ Jr, Perdigão J, Heymann HO. Bonding to enamel and dentin: a brief history and state of the art, 1995. *Quintessence Int*. 1995;26(2):95-110.
15. Tanner J, Smith B, Rueggerberg F, Haywood V. Effect of dentist-prescribed home bleaching on orthodontic bracket retention. *J Dent Res*. 2001;80(1 suppl):205.
16. Lai SC, Tay FR, Cheung GS, et al. Reversal of compromised bonding in bleached enamel. *J Dent Res*. 2002;81(7):477-481.
17. Polat Ö. Pain and discomfort after orthodontic appointments. *Semin Orthod*. 2007;13(4):292-300.
18. Haywood VB, Caughman WF, Frazier KB, Myers ML. Tray delivery of potassium nitrate-fluoride to reduce bleaching sensitivity. *Quintessence Int*. 2001;32(2):105-109.
19. Curtis JW Jr, Dickinson GL, Myers ML, Russell CM. Evaluating the effects of a dentist-supervised, patient-applied carbamide peroxide bleaching agent on oral soft tissues. *J Esthet Dent*. 1995;7(1):18-25.